Oct. 2, 1945. R. HEBERLEIN 2,385,918

APPARATUS FOR VARYING THE ANGULAR RELATION OF DRIVEN MEMBERS

Filed June 12, 1943 2 Sheets-Sheet 1

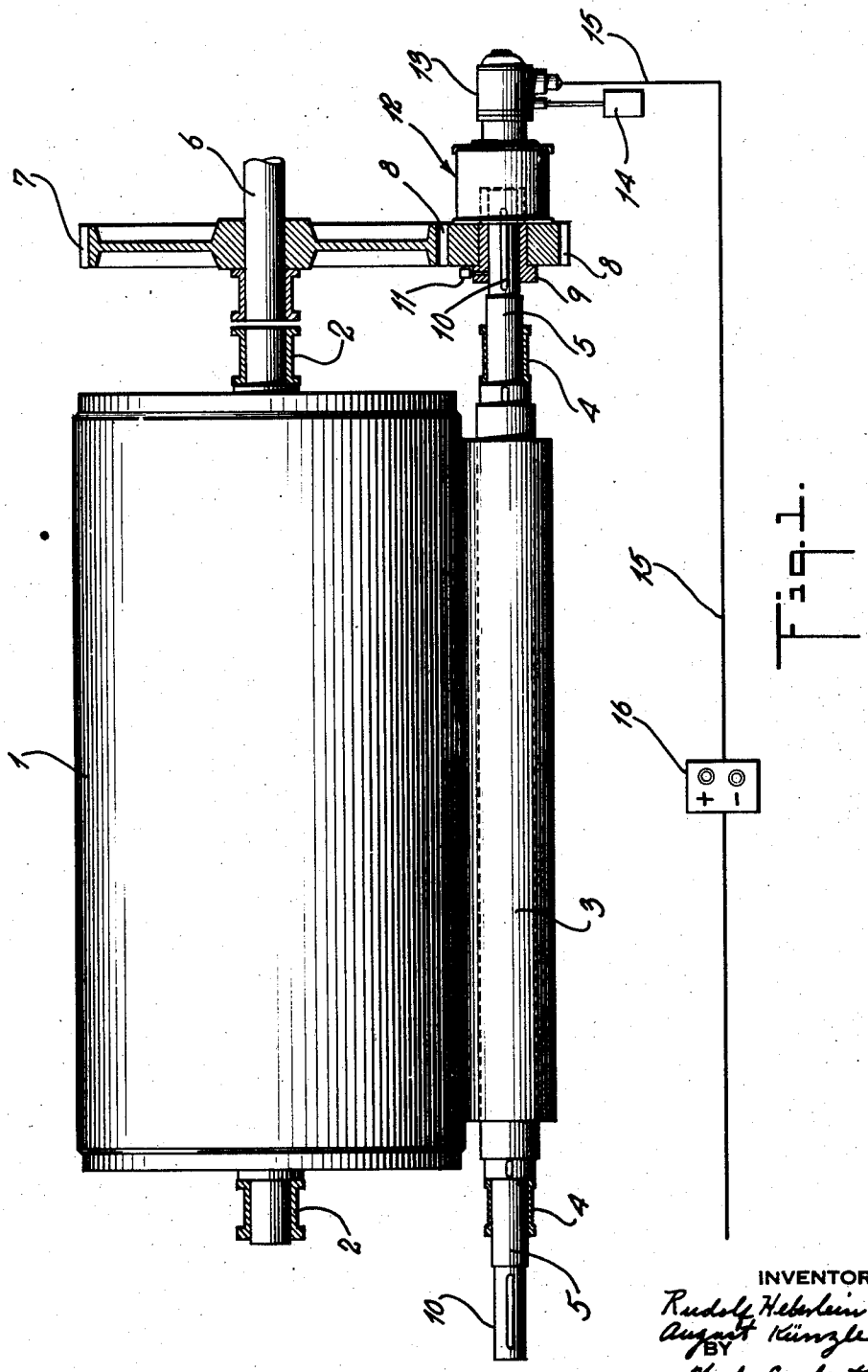


Fig. 1.

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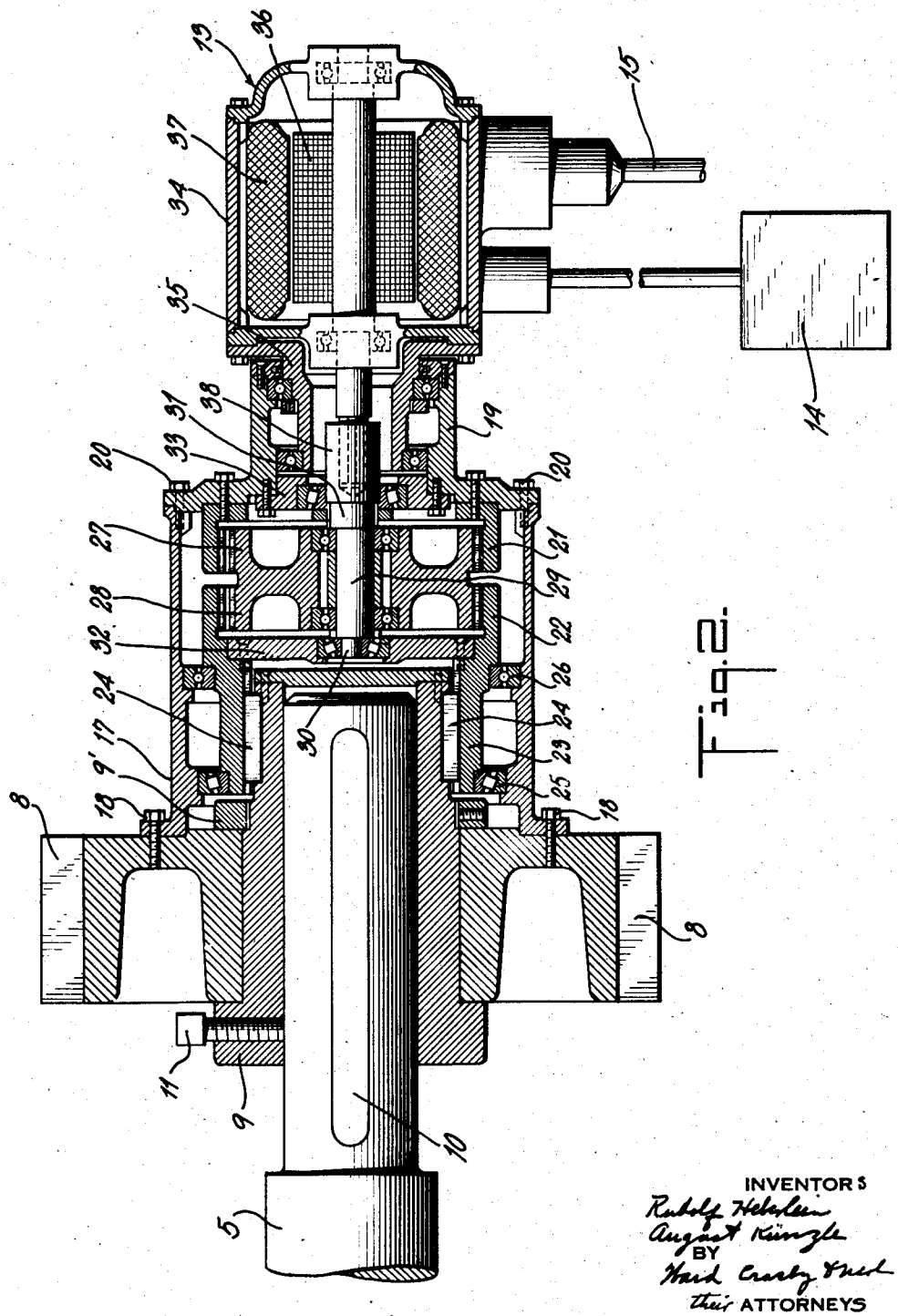


Fig. 2.

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APPARATUS FOR VARYING THE ANGULAR RELATION OF DRIVEN MEMBERS

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6 Claims. (Cl. 74—395)

This invention relates to apparatus for varying the angular relation of a driven member during its rotation. Such apparatus is especially useful for effecting circumferential adjustment of rotating bodies, such for example as printing cylinders when circumferential adjustment is desirable in order to effect registration.

The present invention has been successfully embodied in textile printing machines and such embodiment will be described herein by way of illustration.

Various forms of register adjustment have been proposed and utilized heretofore in connection with fabric and other printing machines as well as in machines for handling paper and other web material wherein angular adjustment of one or more rotating members is desirable. Certain of the prior art apparatus employ a mechanical transmission between a drive shaft and a driven shaft and effect the angular adjustment of the driven shaft relative to the driving shaft by manipulation of the transmission. It is desirable that such manipulation take place while the shafts are rotating (as well as while stationary) and this is referred to as a running adjustment. It is desirable that such running adjustment be made possible from the operator's station somewhat removed from the location of the transmission, and hence electric motors have been utilized for controlling such adjustment. Transmissions and actuating electric motors are conveniently carried by the rotating shaft and this has led to certain complications and difficulties in providing suitable transmission mechanism and in supplying electrical power to the motor for its operation. A common means of supplying such power, by means of slip rings, is disadvantageous since it requires the use of fixed contacts or brushes supported adjacent thereto and maintaining said rings and brushes clean and in intimate contact.

An object of the present invention is to provide improved apparatus for effecting angular adjustment between a rotatable member and its driving means either at rest or during operation.

Another object of the invention is to provide a simplified and dependable transmission for effecting such adjustment.

Another object of the invention is to provide apparatus for such running adjustment in which the power supply line may be directly connected to a suitable motor for adjusting said transmission.

The invention consists in the novel features of construction, arrangement and combination of parts embodied, by way of example, in the apparatus hereinafter described as illustrating a present preferred form of the invention, and the invention will be more particularly pointed out in the appended claims.

Further and more specific objects, features and advantages of the invention will more fully appear from the detailed description given below taken in connection with the accompanying drawings which form a part of this specification, and in which:

Fig. 1 is a side view showing portions of a textile printing machine embodying the invention; and

Fig. 2 is a sectional view showing further details of running adjustment register means in accordance with the present invention.

Referring to the drawings and more particularly to Fig. 1: An impression cylinder is designated as 1 and is freely rotatably journaled in bearings such as 2—2 which are suitably supported on the machine frame (not shown). The impression cylinder 1 is engaged by and adapted to be frictionally driven by a plurality of circumferentially spaced printing rolls, such as 3, only one of which is shown for the sake of simplicity. The printing rolls 3 are rotatably supported in suitable bearings such as 4—4 mounted on the machine frame (not shown). The printing rolls 3 are provided with outwardly extending shaft ends by means of one of which, such as 5, the printing rolls are driven in a manner to be now more particularly described.

Driving power is supplied by a main drive shaft 6 which is coaxial with impression cylinder 1 and carries a central gear wheel 7 fixed thereto and in driving engagement with a spur gear 8 which is freely rotatably journaled and suitably restrained against axial movement on a hollow shaft 9 provided with a spline or key connection extending into a groove, such as 10, formed in the driven shaft 5 to provide for axial adjustment of the shaft 5 with respect to the gear 8, thus permitting lateral registration adjustment of the roll 3. The hollow shaft 9 may be rigidly secured to the driven shaft 5 in the desired position axially thereof by suitable locking means, such as 11. The driving gear 8 is connected with the driven shafts 5 and 9 by means of a transmission designated in its entirety as 12, and said transmission 12 is adapted to be adjusted, to effect circumferential register, by means of a rotary motor, such as an electrical motor, designated in its entirety as 13. The housing of the motor 13 is freely rotatably supported and is held

against rotation by means of a pendulum weight 14 thereby permitting a permanent and direct attachment of the motor 13 to an electrical power line 15 which preferably has interposed in its circuit a suitable fuse set 16 and a suitable switch (not shown) located at the control station. It is understood that each driven shaft of the respective printing rolls is provided with similar transmission and adjustment means, and the electrical control switches for the respective rolls are all situated at the control station. Further details of the adjustment mechanism will now be more fully described.

Referring more particularly to Fig. 2, a transmission housing 17, which functions as a hollow drive shaft, is rigidly secured to the gear 8 as by means of bolts, such as 18. The housing 17, the gear 8 and the hollow shaft 9 may be concentrically disposed with respect to the axis of the shaft 5. For purposes of convenience in assembly, the housing 17 is provided with a removable end 19 made integral therewith by means of screws, such as 20. To the inner face of the housing end 19 there is rigidly secured an internal ring gear 21 concentric with the shaft 5 and which comprises the driving gear of the transmission. A complementary and similar internal ring gear 22 is disposed coaxially of the gear 21 and provides the driven gear of the transmission, and in the present embodiment is formed as an integral part of a sleeve 23 whose inner end surrounds the shaft 9 and is rigidly secured thereto by suitable means, such as keys 24. In order to provide a suitable support for the transmission housing 17, suitable ball-bearing units, such as 25 and 26, are disposed between the cylindrical housing wall and the sleeve 23, and the sleeve 23 is preferably tapered to facilitate assembly from the outer end of the housing.

A planet gear 27, whose external diameter is smaller than the internal diameter of the ring gear 21, is in mesh with the ring gear 21 and is integrally formed with a complementary planet gear 28 in mesh with and of smaller diameter than the ring gear 22. In the present embodiment, these planet gears are provided with a common hub, but of course likewise may be separately formed but rigidly secured together. The common hub is journaled on the eccentric portion 29 of a crank shaft whose inner end 30 and outer end 31 are disposed coaxially of the shaft 5. The inner end 30 is freely rotatably supported, as by ball bearings or roller bearings mounted in a disk 32 which is rigidly secured to the sleeve 23; and the outer end 31 is similarly supported from a disk 33 rigidly secured to the housing end 19. Likewise the hub of planet gears 27—28 is freely rotatably journaled on the crank shaft eccentric portion 29 by means of suitable ball bearings. The electrical motor 13 has a housing 34 which is provided with an inwardly extending journal sleeve 35 freely rotatably supported within an outwardly extending portion of the transmission housing end 19 by means of suitable ball bearing units interposed between the housing portions, and suitable means is provided for securing motor housing 34 against axial displacement relative to the transmission housing. The axis of the motor is thus disposed coaxially of the shaft 5. The motor of the present embodiment is an induction type motor having a short-circuited armature, and is provided with a rotor 36 and a stator 37 which are likewise coaxial with the shaft 5. The shaft of the rotor 36 is directly connected to the outer end 31 of the crank shaft by a suitable coupling 38.

As will be seen from the drawings, the various ball bearings or roller bearings supporting the ends 30, 31 of the crank shaft and the inner end of the motor housing 34 are arranged in tapered relation to facilitate assembly.

In the present embodiment, an electrical motor of about 1/50 H. P has been found satisfactory and the ratio of the transmission of the planetary gear of about 1:10,000 has been found satisfactory. The electrical motor is reversible and accordingly forward and reverse electrical control means can be employed.

Operation

Power is transmitted from the shaft 6 through the gear wheel 7 to the driving gear 8 which in turn carries with it the transmission housing 17 and the transmission driving gear 21, which in turn rotates the planet gear 27 about its axis 29; and the attached planet gear 28 is thus caused to rotate the driven gear 22 which thereby drives the shaft 9 and the rotatably attached shaft 5, thus causing the printing roll 2 to be driven, which in turn frictionally drives the impression roll 1. During this operation, there is a relative rotation between the driving gear 8 and the driven shaft 5 on the one hand, and the housing 34 and stator 37 of the electrical motor on the other hand. Likewise all of the parts of the planetary gear simultaneously rotate concentrically with the housing 17; but only as long as the crank shaft end 32 of the planetary gear is not driven by the motor 13. However, when it is desired to angularly adjust the driven member, the actuating switch is closed and as soon as the current is supplied to the motor 13, the rotor drives the crank shaft 29—31 causing its eccentric portion 29 to revolve about the ends 30—31 which are coaxial with the shafts 9 and 5: which causes the planet gears to revolve about the axis of the shaft 5 on account of the very high transmission of the plentary gear, and they will continue to revolve very slowly and only so long as the motor runs; thus causing a relative angular movement between the driving member 17 and the driven member 5. During rotation of the rotor, the stator is held against rotation by means of the weight 14, which is sufficient to overcome the reaction of the rotor torque. Inasmuch as the printing rollers are driven from the central gear 7, by way of the drive member or housing 17, in a positive manner; the shifting of the circumferential position of one of the printing rollers, such as 2, with respect to the housing 17, or the main drive shaft 6, results also in a corresponding shifting of its circumferential position with respect to the other printing rollers, i. e., in a changing of the register or adjustment.

This invention is especially suitable for use in fabric printing. As is well-known, an impression cylinder is covered with a layer of fabric and, in the embodiment illustrated, is driven by the friction of the several printing rollers engaging the periphery of the covered impression cylinder surface. Such covering is not always uniformly firm and resilient and furthermore the thickness of the copper jackets of the printing cylinder varies. For these reasons it is usual to have the teeth of the gears, such as the spur gear 8 and the central gear 7, rather coarse and with some play in order to permit desirable adjustment of the printing rollers in a direction transverse their axes, so that the rollers may be brought into the desired position against the impression cylinder 1. The

present invention complies with these requirements in every respect inasmuch as all of the parts commencing with the gear 8 and including the electrical motor 13 are carried by and movable with the shaft 5 of the printing roller 2, and are therefore freely shiftable with the printing roller, toward or away from the impression cylinder, without in any way interfering with even the direct power line connection to the motor 13.

Having thus described our invention with particularity, with reference to the preferred embodiment of the same, and having referred to certain modifications thereof, it will be obvious to those skilled in the art, after understanding our invention, that other changes and modifications may be made therein without departing from the spirit or scope of our invention and we aim in the appended claims to cover such changes and modifications as are within the scope of the invention.

What we claim is:

1. In apparatus for varying the angular relation of a member during its rotation, the combination of a rotatable member to be driven, rotatable means for driving said member, a transmission drivingly interconnecting said driving means and driven member; said transmission comprising a pair of internal gears concentric with said driven member, one of said gears being rigidly secured to said driving means and the other being rigidly secured to said driven member, planet gear means in respective driven and driving engagement with said driving and driven internal gears and means freely rotatably mounting said planet gear means about an axis of rotation eccentric to said pair of internal gears and rotatably about an axis of revolution concentric with said pair of internal gears; and means for revolving said planet gear means about said concentric axis.

2. In apparatus for varying the angular relation of a member during rotation, the combination of a first rotatable member to be driven, a second rotatable member to drive said first member, transmission means drivingly connecting said first and second members and comprising driving and driven gears coaxial with said first member and an intermediate planet gear in mesh with said driving and driven gears and means for supporting said planet gear freely rotatably about an axis of rotation eccentric and parallel to said first member and about an axis of revolution coaxial with said first member, and a rotary motor having a stator and a rotor supported coaxially of said first member and relatively rotatable with respect thereto, said rotor being in driving engagement with said planet gear supporting means, whereby upon the operation of said motor said planet gear is revolved about the axis of said first member.

3. In apparatus for varying the angular relation of a member during rotation, the combination of a shaft to be driven, rotatable means for driving said shaft, a first internal gear rotatably fixed to said driving means concentric with said shaft, a second internal gear rotatably fixed to said shaft concentric therewith, a first planet gear eccentric to and in driven engagement with said first internal gear, a second planet gear coaxial with and rotatably fixed to said first planet gear and in driving engagement with said second internal gear, an electrical motor having a stator and a rotor coaxial with said driven shaft and freely rotatably supported from said rotatable driving means, eccentric drive means in driven engagement with the rotor of said motor and providing an eccentric axle support on which said planet gears are freely rotatably journaled, whereby upon rotation of said rotor said planet gears are caused to revolve about the axis of said driven shaft to thereby effect relative angular adjustment of said driven shaft and driving means, and means resisting the torque reaction exerted on said motor stator during the rotation of said rotor to thereby prevent the rotation of said stator.

4. In apparatus for varying the angular relation of a drive shaft relative to a driven shaft during rotation of said shafts, the combination of a shaft to be driven, a drive shaft, a drive gear driven from said drive shaft and freely rotatably journaled about said driven shaft, a transmission housing rigidly secured to said drive gear for rotation therewith, a first internal gear rotatably carried by said housing concentric with said driven shaft, a second internal gear rotatably carried by said driven shaft concentric therewith and rotatable with respect to said first internal gear, a first planet gear in mesh with said first internal gear, a second planet gear in mesh with said second internal gear and rigidly fixed to said first planet gear for rotation therewith, means for freely rotatably mounting said planet gears about a common axis of rotation eccentric to said driven shaft and about a common axis of revolution concentric to said driven shaft, an electric motor having a stator freely rotatably supported from said transmission housing concentric with said driven shaft and having a rotor rotatably supported concentric said driven shaft and in driving engagement with said planet gears for revolving the same about the axis of said driven shaft, and weight means suspended from said stator for resisting the torque reaction resulting from the rotation of the rotor when the motor is operated and thereby preventing the rotation of the stator.

5. In apparatus for varying the angular relation of a drive gear relative to a driven shaft during rotation of said shaft, the combination of a shaft to be driven, a drive gear freely rotatably journaled about and carried by said driven shaft, a transmission housing rigidly secured to said drive gear for rotation therewith, a first internal gear disposed within and fixed to said housing concentric with said driven shaft, a second internal gear rotatably carried by said driven shaft and concentric therewith and rotatable with respect to said first internal gear, a first planet gear in mesh with said first internal gear, a second planet gear in mesh with said second internal gear and rigidly secured to said first planet gear for rotation therewith, a crank shaft freely rotatably mounting said planet gears about a common axis of rotation eccentric to said driven shaft and about a common axis of revolution concentric to said driven shaft, said crank shaft having its opposite ends freely rotatably mounted about its central axis in journals respectively supported by said housing and said shaft, an electric motor having a stator with a housing therefor freely rotatably supported from said transmission housing concentric with said driven shaft and having a rotor rotatably supported concentric said driven shaft and in direct driving engagement with said crank shaft for revolving said planet gears about the axis of said driven shaft, and means for preventing the rotation of said stator.

6. In apparatus for varying the angular relation of a drive gear relative to a driven shaft during rotation of said shaft, the combination of a shaft to be driven, a drive gear freely rotatably

journaled about said driven shaft, a transmission housing rigidly secured to said drive gear for rotation therewith and extending outwardly therefrom, a first internal gear rotatably carried by said housing concentric with said driven shaft, a sleeve within said housing and concentric said shaft with its inner end fixed to said shaft, a second internal gear rotatably carried by the outer end of said sleeve and concentric with and rotatable with respect to said first internal gear, a planet gear wheel in mesh with said first and said second internal gears for drivingly connecting the same, a crank shaft freely rotatably mounting said planet gear about a common axis of rotation eccentric to said driven shaft and about a common axis of revolution concentric to said driven shaft, a journal support rotatably carried by said sleeve for supporting the inner end of said crank shaft, a journal support rotatably carried by said housing for supporting the outer end of said crank shaft, an electric motor having a housing freely rotatably journaled in the outer end of said transmission housing concentric with said driven shaft and having a rotor rotatably supported concentric said driven shaft and drivingly connected to said crank shaft for revolving said planet gear about the axis of said driven shaft, said motor having fixed connections with electrical supply lines, and weight means suspended from said motor housing for absorbing the torque reaction resulting from the rotation of the rotor when the motor is operated and thereby preventing the rotation of the motor housing.

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